Response Under 37 C.F.R.§1.116
Expedited Procedure
Examining Group 2815

REMARKS

Response to §103 Rejections of Claims 15-20

In the August 25, 2005 Office Action, the Examiner rejected claims 15-20 of the present application under 35 U.S.C. §103(a), as alleged obvious over U.S. Patent No. 6,348,394 issued to Mandelman et al. (hereinafter "Mandelman") in view of U.S. Patent Application Publication No. 2004/0155275 published in the names of Divakaruni et al. (hereinafter "Divakaruni") and U.S. Patent No. 6,156,620 issued to Puchner et al. (hereinafter "Puchner").

Applicants respectfully traverse the Examiner's rejections, based on the following patentable distinctions between the claimed invention of the present application and the disclosures of the cited references.

I. Patentable Distinctions of Claims 15-16 and 18-20 Over the Cited References

Claim 15, from which claims 16 and 18-19 depend, has been hereby amended to positively recite "a trench dielectric material" that "comprises nitrogen species."

Support for such a claim amendment is provided by the instant specification on pages 12-13, paragraphs [0062] and [0063], which describe formation of a nitride liner 68 along the interior and exterior sidewalls and bottom walls of a trench isolation region, by using a plasma nitridation process that occurs after the trench 60 has been filled with a trench dielectric material 70. Such plasma nitridation process inevitably introduces nitrogen species into the trench dielectric material 70.

The Puchner reference discloses formation of a nitrogen-containing barrier region 50 or 54 by a nitrogen plasma process, before the trench 30 is filled with a trench filler material 80 (see Puchner, Figures 8 and 13, column 5, lines 49-56 and column 6, lines 38-43). More importantly, Puchner discloses that a silicon oxide layer 70 is formed over the nitrogen-containing barrier region 50, in order to "confine the nitrogen atoms in barrier region 50 from diffusing to other

filler materials in trench 30" (see Puchner, column 5, lines 24-26). Therefore, the trench filler material 80 disclosed by Puchner does **not** contain nitrogen species, while in contrast, the claimed invention of the present application, as recited by claims 15-16 and 18-20, expressly recites a trench dielectric material that comprises nitrogen species.

Mandelman discloses a trench oxide filler 17 that is formed by a high-density plasma (HDP) chemical vapor deposition process, after formation of a nitride liner 16 by a low-pressure chemical vapor deposition (LPCVD) process or a rapid thermal chemical vapor deposition (RTCVD) process (see Mandelman, Figure 1D, column 3, lines 22-37). Therefore, the trench oxide filler 17 also does **not** contain nitrogen species and cannot remedy the deficiency of the Puchner reference.

Divakaruni discloses a trench top oxide 28 that is formed by a high-density plasma (HDP) chemical vapor deposition process, after formation of a nitride liner 50 (see Divakaruni, Figure 2(b), page 3, paragraph [0040]). Therefore, like Puchner and Mandelman, Davakaruni also discloses a trench filler that does **not** contain nitrogen species.

In summary, claims 15-16 and 18-20 patentably distinguishes over all the cited references, i.e., Puchner, Mandelman, and Divakaruni, by expressly reciting a trench dielectric material that comprises nitrogen species therein. Such a feature is not taught or suggested in the prior art references cited in the present Office Action. Moreover, there is no motivation in the applied prior art which suggests modification of their trench fill material to include nitrogen species, as presently claimed.

II. Patentable Distinction of Claim 17 Over the Cited References

Claim 17 of the present application has been rewritten into independent form and expressly recites a trench isolation region containing a nitrided surface layer that has "a thickness of about 0.1 to about 2.0 nm." Support for such limitation is provided in claim 17 as originally filed, as well as in the instant specification, page 11, paragraph [0058].

In a previous Office Action dated March 16, 2005, the Examiner conceded that the Mandelman reference fails to teach the use of very thin nitride layers having thickness between 0.1 to 2.0 nm, but attempted to remedy such a deficiency of Mandelman by citing the Divakaruni reference, which discloses a nitride layer of about 1 nm thick (see the March 16, 2005 Office Action, page 3, first paragraph).

Applicants respectfully disagree with the Examiner's reasoning for combining the Mandelman and Divakaruni references, for the following reasons.

It has been well established it is improper for the Examiner to combine references where the references *teach away* from the combination. In re Grasselli, 218 USPQ 769 (Fed. Cir. 1983). The Examiner cannot "*disregard[ing] disclosures in the references that diverge from and teach away from the invention at hand.*" Panduit Corp. v. Dennison Manufacturing Co., 227 U.S.P.Q. 337 (CAFC 1985).

Mandelman discloses a trench isolation region that contains a nitride liner for trapping charge therein, so as to control array threshold voltage (see Mandelman, column 1, lines 52-59). Specifically, Mandelman teaches that the preferred thickness for the nitride liner is greater than 5.5 nm, that the threshold voltage shift continues to increase with the nitride liner thickness until the nitride liner thickness reaches between 9 nm and 11 nm, and that there is no upper limit for the nitride liner thickness, because there is no deleterious effect for use of thicker nitride liner (see Mandelman, column 4, lines 40-46).

Mandelman shows a strong preference for thick nitride liners (i.e., > 5.5 nm thick), which diverges from and **teaches away** from use of thin nitride liners with thickness ranging between 0.1 nm and 2.0 nm, as expressly recited by claim 17 of the present invention.

In light of the express disclosure of Mandelman away from use of thin nitride liners, a person ordinarily skilled in the art, after reading Mandelman, would **not** have been motivated to incorporate the thin trench top oxide (TTO) nitride liner disclosed by Divakaruni, which is used

in trench capacitor structures (see page 1, paragraph [0003] of Divakaruni), into the trench isolation structure disclosed by Mandelman.

Therefore, Divakaruni cannot be properly combined with the Mandelman reference and thus does not remedy the deficiency of Mandelman.

The Puchner reference is silent on the thickness of the thickness of the nitride barrier region 54 and therefore also fails to remedy the deficiency of Mandelman.

As a result, claim 17 is patentably distinguished over the cited references, by reciting a trench isolation region containing a nitrided surface layer that has a thickness of about 0.1 to about 2.0 nm.

CONCLUSION

Based on the foregoing, claims 15-20 as amended herein are in condition for allowance. Issue of a Notice of Allowance for the application is therefore requested.

If any issues remain outstanding, incident to the formal allowance of the application, the Examiner is requested to contact the undersigned attorney at (516) 742-4343 to discuss same, in order that this application may be allowed and passed to issue at an early date.

Respectfully submitted,

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